

## Advanced Sensor Technology for Algal Biotechnology

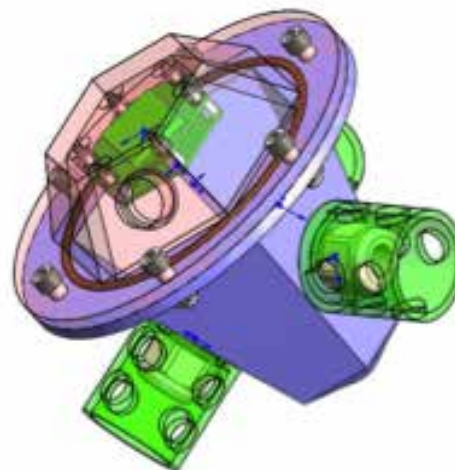


### Environmental monitoring of microbe metabolic transformation

Advanced Sensing Technology for Algal Biotechnology (ASTAB) is an integrated package of water quality and algal physiology sensors for the algal biotechnology industry. This sensor technology is expected to significantly increase the productivity of algal growth systems by facilitating process automation and increasing performance in large scale algal production facilities. ASTAB is a small neutrally buoyant instrumented package which travels throughout algal growth systems (e.g., photobioreactors, raceways, ponds, bags, and tubes) with water flow. Multiple sensing capability for physical, chemical, and biological parameters are incorporated. Position information, and data on physical and biological parameters in the raceway or pond, are transmitted via a wireless network. Data can be “read alone” or used to control local automatic devices to make appropriate changes to water quality (e.g., nutrient additions, pH control, and other). ASTAB can be stand alone, providing continuous real time data to operators, or can be interfaced with prognostics software in development to generate biomass production forecasts or detect system failure at early onset.

#### BENEFITS

- Sensors provide real time quantitative data
- Wireless connectivity
- Can interface to automation controls
- Avoid loss of batches of algae and/or early detection of problems
- Inexpensive so multiple units can be deployed
- Enable creation of 3D maps
- Ease of calibration
- Anti-fouling, self-cleaning
- Detect “dead spots”



*CAD Concept for RoboAlgae*

technology opportunity

# Advanced Sensor Technology for Algal Biotechnology: Technology Detail

Advanced Sensors for Algal Biotechnology (ASTAB), or “RoboAlgae” is developed for deployment in high rate algal ponds operated by commercial growers. This technology determines a suite of important water quality attributes using conventional techniques while simultaneously determining the photophysiological state of the algae using PAM (Pulse Amplitude Modulation) fluorometry. To lower costs, the final sensing package is constructed using commercially available off the shelf technology (COTS) sensors integrated into custom packaging using miniaturization technologies previously developed and deployed in NASA nanosatellite platforms (which are absolutely required to work autonomously and reliably). Data is returned by the sensing system via wireless networks to a central processing station. The sensors quantify: a) physical parameters (e.g., temperature, light; turbidity; flow), b) chemical parameters (e.g., dissolved oxygen, oxidation reduction potential, pH, conductivity, bicarbonate, ammonium, and nitrate), and c) biological parameters (e.g., multi wavelength fluorometry to identify specific algal or contaminant species, and PAM fluorometry). PAM fluorometry is an optical technique that provides an immediate assessment of the photosynthetic efficiency (e.g., conversion of light into chemical energy) of algae or the “health” of the algae. Movable sensors packages will deploy wireless connectivity with accurate position information which could be used to create 3D maps and detect “dead spots”. The systems features solar power and anti-fouling and/or self cleaning technologies.

## APPLICATIONS

- Real time monitoring of both environmental conditions and algal physiology
- Quick assessment of photosynthetic efficiency or “health” of algae using PAM fluorometry
- Mobile system providing data from multiple locations in large systems
- Can be used in other liquid platforms requiring sensing (wastewater, aquaponics, hydroponics)



Prototype Testing in Imperial Valley, California

## Patents

This technology has been patented (U.S. Patent 8,412,469).  
Reference: ARC-16342-1.

## Licensing and Partnering Opportunities

NASA’s Technology Transfer Program seeks to transfer this technology out of NASA’s space program to benefit U.S. industry. NASA invites companies to inquire about licensing possibilities for this technology for commercial applications.

### Learn More

*For more information on this technology, and to discuss licensing and partnering opportunities, please contact:*

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